

Amendments to the claims:

Please amend the claims as set forth below. This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of claims:

Claim 1. (currently amended) A method for fabricating high light extraction photonic devices, comprising:

growing an Group-III nitride epitaxial semiconductor device structure on a silicon carbide (SiC) substrate, said epitaxial semiconductor structure and substrate comprising an emitter adapted to emit light in response to a bias;

flip-chip mounting said emitter on a submount such that said epitaxial semiconductor device structure is sandwiched between said submount and said substrate, and

etching said substrate off said epitaxial semiconductor device by utilizing an etch environment that etches said substrate substantially faster than said epitaxial semiconductor structure.

Claim 2. (cancelled)

Claim 3. (currently amended) The method of Claim 1, wherein said substrate comprises a monocrystalline material.

Claim 4. (currently amended) The method of Claim 1, wherein said substrate comprises monocrystalline silicon carbide (SiC).

Claim 5. (original) The method of Claim 1, wherein said etch environment comprises a reactive ion etch.

Claim 6. (original) The method of Claim 1, wherein said etch environment comprises nitrogen trifluoride (NF_3).

Claim 7. (currently amended) The method of Claim 1, further comprising depositing a first mirror layer on said epitaxial semiconductor structure opposite said substrate structure prior to said flip-chip mounting of said emitter, said mirror sandwiched between said epitaxial semiconductor structure and said submount after said flip-chip mounting.

Claim 8. (original) The method of Claim 7, wherein said first mirror layer comprises a reflective metal.

Claim 9. (original) The method of Claim 7, wherein said first mirror layer comprises a distributed Bragg reflector (DBR) comprising a plurality of alternating layer pairs of dielectric material.

Claim 10. (currently amended) The method of Claim 9, wherein each of said layer pairs comprise a layer of silicon dioxide (SiO_2) and a layer of titanium dioxide (TiO_2), or a layer of silicon dioxide (SiO_2) and a layer of tantalum pentoxide (Ta_2O_5), ~~the thickness of said pairs of layers having a thickness equally~~ a approximately equal to a quarter of said wavelength of said emitted light.

Claim 11. (original) The method of Claim 9, wherein said layer pairs repeat two to four times.

Claim 12. (original) The method of Claim 7, wherein said first mirror layer comprises an epitaxial DBR comprising a plurality of alternating layer pairs of epitaxial material.

Claim 13. (currently amended) The method of Claim 12, wherein each of said alternating layer pairs comprises a layer of gallium nitride (GaN) and a layer of aluminum nitride (AlN), or a layer of gallium nitride (GaN) and a layer of an alloy of aluminum nitride (Al₂X_yN), said alternating layer pairs having a thickness approximately equal to a quarter of said wavelength of said emitted light.

Claim 14. (original) The method of Claim 12, wherein said pairs of layers repeats eight to twelve times.

Claim 15. (currently amended) The method of Claim 1, wherein said submount comprises one of the materials from the group consisting of ~~monocrystalline~~ silicon carbide (SiC), a silicon substrate, sapphire, metal and glass.

Claim 16. (original) The method of Claim 1, further comprising depositing a second mirror layer on said epitaxial semiconductor structure after said substrate has been etched, said second mirror layer arranged such that said epitaxial semiconductor structure is sandwiched between said submount and said second mirror layer.

Claim 17. (original) The method of Claim 16, wherein said second mirror layer comprises a reflective metal.

Claim 18. (original) The method of Claim 16, wherein said second mirror layer comprises a distributed Bragg reflector (DBR) comprising a plurality of alternating layer pairs of dielectric material.

Claim 19. (currently amended) The method of Claim 18, wherein each of said layer pairs comprise a layer of silicon dioxide (SiO_2) and a layer of titanium dioxide (TiO_2), or a layer of silicon dioxide (SiO_2) and a layer of tantalum pentoxide (Ta_2O_5), the thickness of said layer pairs equal to approximately a quarter of said wavelength of said emitted light.

Claim 20. (original) The method of Claim 18, wherein said layer pairs repeat two to four times.

Claim 21. (original) The method of Claim 16, wherein said second mirror layer comprises an epitaxial DBR comprising a plurality of alternating layer pairs of epitaxial material.

Claim 22. (currently amended) The method of Claim 21, wherein each of said alternating layer pairs comprises a layer of gallium nitride (GaN) and a layer of aluminum nitride (AlN), or a layer of gallium nitride (GaN) and a layer of an alloy of aluminum nitride ($\text{Al}_x\text{X}_y\text{N}$), said alternating layer pairs having a thickness approximately equal to a quarter of said wavelength of said emitted light.

Claim 23. (original) The method of Claim 21, wherein said pairs of layers repeats eight to twelve times.

Claim 24. (original) The method of Claim 1, wherein growing an epitaxial semiconducting structure comprises:

growing a first epitaxial semiconductor layer on said substrate, and

growing a second epitaxial semiconductor layer on said first epitaxial semiconductor layer, such that said first semiconductor layer is sandwiched between said substrate and said second semiconductor layer.

Claim 25. (original) The method of Claim 24, wherein growing an epitaxial semiconducting structure comprises growing thin doped layers and forming a resonant cavity light emitting diode.

Claim 26. (currently amended) A method for fabricating high light extraction photonic devices, comprising:

growing an epitaxial semiconductor structure on a silicon carbide substrate;

depositing a first mirror layer on said epitaxial semiconductor structure such that said epitaxial semiconductor structure is sandwiched between said first mirror layer and said substrate;

removing said substrate from said epitaxial structure by introducing an etch environment to said substrate; and

depositing a second mirror layer on said epitaxial semiconductor structure such that said epitaxial semiconductor structure is sandwiched between said first and second mirror layers.

Claim 27. (original) The method of Claim 26, wherein said etch environment etches said substrate substantially faster than said epitaxial semiconducting structure, etching off substantially

all of said substrate without etching off substantially any of said epitaxial semiconducting structure.

Claim 28. (original) The method of Claim 26, wherein said epitaxial semiconductor structure is adapted to emit light in response to an electrical signal.

Claim 29. (currently amended) The method of Claim 26, wherein said epitaxial semiconductor structure comprises a Group-III nitride semiconductor material.

Claim 30. (currently amended) The method of Claim 26, wherein said substrate comprises monocrystalline silicon carbide (SiC).

Claim 31. (original) The method of Claim 26, wherein said etch environment comprises a reactive ion etch.

Claim 32. (original) The method of Claim 26, wherein said etch environment comprises nitrogen trifluoride (NF₃).

Claim 33. (original) The method of Claim 26, wherein either of said first or second mirror layers comprise a reflective metal.

Claim 34. (original) The method of Claim 26, wherein said either first or second mirror layer comprise distributed Bragg reflector (DBR) mirror having alternating layer pairs of dielectric material.

Claim 35. (currently amended) The method of Claim 34, wherein each of said layer pairs comprise a layer of silicon dioxide

(SiO₂) and a layer of titanium dioxide (TiO₂), or a layer of silicon dioxide (SiO₂) and a layer of tantalum pentoxide (Ta₂O₅).

Claim 36. (original) The method of Claim 26, wherein either of said first or second mirror layers comprise an epitaxial DBR mirror alternating layer pairs of epitaxial material.

Claim 37. (currently amended) The method of Claim 36, wherein each of said alternating layer pairs comprises a layer of gallium nitride (GaN) and a layer of aluminum nitride (AlN), or a layer of gallium nitride (GaN) and a layer of an alloy of aluminum nitride (Al_zX_yN).

Claim 38. (currently amended) The method of Claim 26, further comprising flip-chip mounting said first mirror layer, epitaxial semiconductor structure and substrate combination on a submount after depositing said first mirror, such that said first mirror layer is adjacent to said submount and said first mirror layer and ~~eitaxial~~ epitaxial semiconductor structure is sandwiched between said submount and substrate.

Claim 39. (currently amended) The method of Claim 38, wherein said submount comprises one of the group consisting of monocrystalline silicon carbide (SiC), a silicon substrate and glass.

Claim 40. (currently amended) A resonant cavity light emitting diode (RCLED), comprising:

- a thin film epitaxial semiconductor structure;
- a ~~first~~ first mirror layer on one surface of said ~~eptaxial~~ epitaxial semiconductor structure;

a second mirror layer on another surface of said epitaxial semiconductor structure such that said epitaxial semiconductor structure is sandwiched between said first and second mirrors, said second mirror layer being less reflective than said first mirror layer;

a submount, said epitaxial semiconductor structure with its said first and second mirrors mounted on said submount, said first mirror layer being adjacent to said submount and said second mirror layer being the ~~primary~~ primary emitting surface.

Claim 41. (original) The RCLED of Claim 40, wherein said epitaxial semiconductor device emits light and has a thickness to provide a resonant cavity for said light.

Claim 42. (original) The RCLED of Claim 40, wherein said epitaxial semiconductor device comprises two layers of semiconductor material that are oppositely doped.

Claim 43. (currently amended) The RCLED of Claim 40, wherein said epitaxial semiconductor device comprises ~~and~~ a semiconductor active region sandwiched between two oppositely doped layers.

Claim 44. (original) The RCLED of Claim 40, wherein said either said first or second mirror layer comprise a metal.

Claim 45. (original) The RCLED of Claim 40, wherein said first or second mirror layers comprise a distributed Bragg reflector (DBR) .

Claim 46. (currently amended) A method for removing a silicon carbide substrate from a Group-III nitride epitaxial semiconductor material, ~~compising~~ comprising:

growing a Group-III nitride epitaxial semiconductor material on a silicon carbide substrate;

introducing an etch environment to said silicon carbide substrate, said etch environment etching silicon carbide faster than said Group-III nitride epitaxial material such that said etching substantially stops after said silicon carbide is etched off.

Claim 47. (original) The method of Claim 46, wherein said etch environment comprises a reactive ion etch.

Claim 48. (original) The method of Claim 46, wherein said etch environment comprises nitrogen trifluoride (NF₃) reactive ion etch.